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AN INFESTATION OF MILTOGRAMMINE SARCOPHAGIDAE (DIPTERA: SARCOPHAGIDAE) IN A POPULATION OF *HYBOMITRA LASIOPHTHALMA* (MACQUART) (DIPTERA: TABANIDAE)

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Abstract.—A second isolation of *Macronychia* sp. near *aurata* (Coquillett) was made from adult specimens of Tabanidae in south-central Texas. Fifty-nine sarcophagid larvae were obtained from 270 adult females of *Hybomitra lasiophthalma* (Macquart) which were taken 7–14 April 1977, inclusive, during their peak emergence on the Navasota River floodplain near College Station, Texas. The apparent high incidence of parasites in this tabanid population (22%) is qualified by the observed frequency of multiple parasitism; of 4 parasitized females dissected, 3 suffered multiple infestations of 2, 3 and 5 larvae, respectively. The chronology of parasitization of *H. lasiophthalma* by this sarcophagid suggests that the tabanid serves as a first host species for the parasite, while species of *Tabanus*, such as *Tabanus subsimilis subsimilis* Bellardi, act as hosts of subsequent generations of parasites. Once again, the parasite was found infesting *T. s. subsimilis*.

The isolation of miltogrammine sarcophagid larvae from adult females of *Tabanus subsimilis subsimilis* Bellardi was reported by Thompson (1978). That particular infestation involved a population of this tabanid collected near Easterwood Airport and the sewage treatment plant, College Station, Texas 28 May through 14 July 1976. Subsequently, the sarcophagid parasite was identified as *Macronychia* sp. near *aurata* (Coquillett), hereafter referred to as *Macronychia* sp. The 1978 report considered the chronological and ecological details coincident with the parasitization; methods of rearing the parasite, and its larval behavior; relevant biology for the host and for the parasite; and the implications of these findings for the known life histories of miltogrammine sarcophagids and for the management of noxious populations of Tabanidae.

During a study of *Hybomitra lasiophthalma* (Macquart) the following year, *Macronychia* sp. was again observed commonly infesting females of the host species. The details of this sarcophagid-tabanid association will be compared with those previously recorded for *Macronychia* sp. and *T. s. subsimilis* (Thompson, 1978).

Studies of reproductive physiology of Tabanidae, preparatory to rearing work, were begun with the first spring dominant found in the vicinity of College Station. All females of *Hybomitra lasiophthalma* collected during

Fig. 1. Seasonal distributions of *Hybomitra lasiophthalma* and of *Tabanus subsimilis subsimilis*, showing periods of infestation by *Macronychia* sp.

Table 1. Daily catches of *Hybomitra lasiophthalma* females taken 7–14 April 1977, inclusive, and numbers of infesting *Macronychia* sp. larvae emerging from them.[a]

	Day of April								
	7	8	9	10	11	12	13	14	Totals
No. tabanids	22	34	28	22	42	47	40	35	270
No. sarcophagids	1	6	5	1	5	32	6	3	59
Percent infested	4	18	18	4	12	68	15	9	22

[a] Eleven larvae were excepted; these were found in the abdominal cavities of dissected females.

the period 7–14 April, inclusive, from two Manitoba Traps located on the Navasota River, were held in the lab to observe additional instances of parasitism. Catches were augmented with CO_2 generated from dry ice.

Methods

All dead *H. lasiophthalma* females removed from holding cages in the laboratory were retained together by date in 10-dram glass vials. The centers of the polyethylene lids of these containers were cut out with a heated No. 12 cork borer; and the lids were subsequently lined with a 25-mm disc of 70-mesh brass screen (Brass Strainer Cloth, C. O. Jellif Corp., Southport, Connecticut 06490). These vials of dead flies were examined daily for the presence of parasite larvae and the first larvae were found on 8 April, when they emerged from dead *H. lasiophthalma* females trapped the day before. Sarcophagid specimens were reared on decapitated crickets in glass Petri dishes. Parasites removed from flies taken on the same date were reared together. Further details of rearing were previously described (Thompson, 1978).

Observations

A total of 59 sarcophagid larvae was removed from vials containing 270 adult females of *H. lasiophthalma*. More than half of these (32) emerged from host specimens taken on 12 April, the 6th day of collection (Table 1). Mortality of the larvae was very high (81.4%) in contrast to that suffered by the lesser number of specimens reared from *Tabanus subsimilis subsimilis* (17.7%; Table 2).

Development and behavior.—The periods of parasite larval development and of pupal development, under the same physical conditions as for *T. s. subsimilis*, were considerably longer (Table 2). The high mortalities and attenuated development of parasites found in *H. lasiophthalma* could reflect microbial infection. Again, larval behavior was scavenger like; but

Table 2. Summary data of *Macronychia* sp. infestations in *Hybomitra lasiophthalma* and *Tabanus subsimilis subsimilis*.[a]

	H. lasiophthalma	*T. s. subsimilis*
No. larvae collected	59	27
No. larvae reared	11	14
no. females	7	4
no. males	4	10
Mortality rate (%)	81.4	17.7[b]
Larval period (days)	8–14, avg. 10.3	2–8, median 6
Pupal period (days)	18–20, avg. 18.8	15–17, avg. 15.9
No. tabanid adults	270	3,000 (est.)
Parasitism rate (%)	3–22	1 (est.)
Parasite loads	1,2,3,5 (4)	7,8 (2)

[a] Data on *Tabanus subsimilis subsimilis* presented in detail in Thompson (1977).

[b] Rate based upon 17 larvae reared, rather than 27, because 10 were preserved for taxonomic purposes.

also again, parasites attacked dead hosts via intact cervical membranes (4 instances).

Discussion

Briefly, miltogrammine Sarcophagidae are cleptoparasites of wasps and bees. The two North American species of *Macronychia*, in particular, have been reared from nests of two sphecid wasp genera. The findings relating to tabanid parasitism described here, conflict with those supporting a cleptoparasitic, and thus secondarily parasitic life history for this species.

Multiple parasitism.—First, as with *Tabanus subsimilis subsimilis*, the occurence of multiple infestations in one host suggests that such larvae were specimens that originated together from the same females foraging near the host. (In 3 of 4 host infestations examined in vivo, 2, 3 and 5 larvae were found together in the abdominal cavity.) Secondly, these larvae were the same size.

If these assumptions regarding multiple infestations by sibling larvae are correct, the mode of life of *Macronychia* sp. could be that of a primary parasite. Although another order of insects was involved, Dr. Paul Arnaud of the California Academy of Sciences, San Francisco, called my attention to a documented instance of such primary parasitism by a miltogrammine species. From 2 camel crickets, he isolated 7 larval specimens of *Hilarella hilarella* (Zetterstedt)—specimens which subsequently pupated and emerged (Arnaud, 1954). Dr. K. V. Krombein, Smithsonian Institution, suggested that *Macronychia* species could normally parasitize Diptera and that apparent instances of these flies parasitizing the prey of sphecid wasps

could, instead, represent primary parasitism of other species of Diptera before they fall prey to the wasps (Krombein, personal communication).

Rate of parasitism.—The parasite-host ratio was estimated because host females of *Hybomitra lasiophthalma* were not isolated individually. Assuming that 59 larvae infested host flies singly, this rate would be 22%; conversely, if 8 parasites infested each host (8 was the most observed), this rate would be 3%. Obviously, the actual rate lies between 3% and 22%.

One factor would surely have increased this rate. Dissections of only a few *H. lasiophthalma* females produced 4 specimens with dead or dying larval parasites. Therefore, unless this small sample is atypical, many infesting parasites never completed development.

The host.—(A review of this tabanid, currently in preparation, will detail and document information in the following summary.) Presently, *H. lasiophthalma* is one of the most widespread and abundant species of its genus in North America, extending from British Columbia to Nova Scotia, and south to Texas and Georgia. In southern Canada and the northern United States, where the larvae breed extensively in sphagnum bogs and shrub-sedge marshes, the adults emerge in June and July. As this form extends southward through the eastern states, its distribution is largely confined to rivers where it breeds predominantly in heavy organic soils of floodplain forests and where its seasonal distribution constricts and recedes, the adults emerging over a shorter period in spring, rather than through midsummer, as farther north. In such riverine localities, and their surrounding ridges, this horse fly is often a dominant species and a major pest of cattle and horses. Parity in *H. lasiophthalma* has been described and females oviposit a blackish, tar-like mass of eggs on the leaves of reeds, sedges, cattails and shrubs growing in low areas which locally characterize the larval habitat. As is also typical of other North American species of *Hybomitra* and *Tabanus*, the adults commonly feed on nectars (this is often evidenced by pollen grains on the mouth parts of trapped specimens); often pursue rapidly-moving vehicles; fly near roadside puddles and woodland pools where they frequently touch the water surface, or "dip," as they circle above it; and hover in sunlighted woodland openings (males), probably in frequent association with mating. This tabanid was one of the first North American species reared in the laboratory from eggs collected in the field; and as with the eggs, the larvae and the pupae have been observed and collected from lowland habitats in nature. In addition, the immatures and both sexes of the imago have been described. *Hybomitra lasiophthalma* has been the subject of other studies involving physiology and disease transmission.

The relationship.—Most significant to the association described here, are the chronological facts causally relating populations of the parasite to those of the two known host species of the Navasota River floodplain and its

adjacent uplands. *Macronychia* sp. was first observed in *Tabanus subsimilis subsimilis* during the period 28 May through 14 July 1976; and the following year, in *Hybomitra lasiophthalma*, from 7 through 14 April. Although these infestations were observed in different years, their chronology suggest that *H. lasiophthalma* could serve as an important host for the first generation of sarcophagids; then the 2nd and subsequent generations of the parasite could infest populations of *Tabanus s. subsimilis* or other numerous forms found during the summer months (Fig. 1).

The curve for *T. s. subsimilis* presented here is based upon collections made in the uplands during the previous year (1975; Thompson, 1977); this curve closely corresponds with that taken in the lowlands the same year, but for the following reservation. Catches at the river declined in August, 1975 because of flooding, whereas catches in the uplands continued to increase for 3 weeks after that.

The 6-week interim between infestations of the two host populations, as depicted in this figure, could account for a projected trough between generations, as based upon development times observed in the laboratory (Table 2).

Concerning the seasonal distribution of *Tabanus s. subsimilis*, intensive collections of adults through most of the year in several Texas ecosystems showed that this species, in contrast to *Hybomitra lasiophthalma*, is aseasonal; i.e., it is found continuously throughout 9 months of the year and peaks anytime during most of that period—from late March to late May (Thompson, 1975) or in late summer (Thompson, 1977). Therefore, this horse fly is abundantly accessible as a potential host insect during most of the season.

A second infestation of Tabanus subsimilis subsimilis.—*Macronychia* sp. was again isolated from this species, in this case, from bottomland populations collected with catches of *Hybomitra lasiophthalma*. Two females which had been held in the laboratory for 3 and 7 days, respectively, contained 2 small 2nd-instar larvae (1 female, 12 April); and 1 large 1st-instar larva (1 female, 8 April). Of these specimens observed in the abdominal cavity, one larva in each fly was alive when it was found.

Conclusions

As with *Tabanus s. subsimilis*, the circumstances surrounding collection and retention of *Hybomitra lasiophthalma* preclude any reasonable possibility of unnatural parasitism. With both species, specimens were removed from trap collection containers within the laboratory and were then held alive in the lab with small numbers of their own species (*H. lasiophthalma*) or of other *Tabanus* species (*T. s. subsimilis*). No other insects or extraneous materials of any kind were contained in any cages of

either species. In addition, no miltogrammine sarcophagids were found in Manitoba Trap catches containing infested specimens of these tabanid species. (Several miltogrammine species of other genera have been taken in small numbers from Gressitt Traps.) In fact, the Manitoba Traps used during these and similar studies of the past 13 years, have taken very few numbers of few species of other insects. Finally, infested horse fly specimens were found in numerous samples of the 2 species—8 in the case of *H. lasiophthalma* and 7 for *T. s. subsimilis*; and these samples were isolated from one another in containers inaccessible to other insects the size of *Macronychia*.

The incidence of *Macronychia* parasitism in Tabanidae is now well documented. The extent of this association with the 2 host tabanids named here, and of others locally abundant, remains to be defined by further survey. Parasite-host specificity, and consequent high rates of parasitism, could offer a potential means of managing pest populations of species which otherwise remain unmanaged.

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